

**TITLE: Physiotherapist-led suprascapular nerve blocks for persistent shoulder pain: evaluation of a new service in the UK**

**SHORT TITLE:** Physio-led SSNB for persistent shoulder pain

Salt E.<sup>1,2</sup>, Van der Windt DA.<sup>1</sup>, Chesterton L.<sup>1</sup>, Mainwaring F.<sup>2</sup>, Ashwood N.<sup>2</sup> & Foster NE.<sup>1</sup>

1. Research Institute for Primary Care & Health Sciences, Keele University, UK;

2. Burton Hospitals NHS Foundation Trust, UK.

**Lead author:** Dr Emma Salt, Consultant Physiotherapist, Physiotherapy Department, Queen's Hospital, Belvedere Road, Burton on Trent, DE13 0RB, United Kingdom. Tel: 01283 566 333 ext. 5255. Email: emma.salt@nhs.net.

#### **Word count**

of abstract 246

of text 3565

#### **Acknowledgements**

The authors wish to thank the following staff at Burton Hospitals Foundation Trust: SSNB training (Tajammal Bhatti), research management support (Melanie Rowland and Susan Russell), physiotherapy research facilitator (Alison Burton) and administrative support (Nosakhare Unarhemhen). The authors would also like to thank Martyn Lewis at the Research Institute for Primary Care and Health Sciences for his statistical support.

*Funding:* Post-doctorate research internship supported through an NIHR Research Professorship for NE Foster (NIHR-RP-011-015). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

## **ABSTRACT**

### **Introduction**

This service evaluation explored and reported findings from a new physiotherapist-led service offering suprascapular nerve blocks (SSNBs) to patients with persistent shoulder pain.

### **Methods**

We collected data before the SSNB injection and at 6 weeks and 6 months follow-up from consecutive patients with persistent shoulder pain being treated by physiotherapists or an anaesthetist. Outcomes were patient-reported pain (numerical rating scale (NRS 0 to 10)), patient specific functional score (PSFS), and health-related quality of life (EQ5D-5L). Exploratory analyses compared baseline and follow-up scores within each clinician delivery group (Physiotherapists, anaesthetist).

### **Results**

40 patients (mean age 57 (SD 12); female 63%) received a SSNB from a physiotherapist, 8 patients (mean age 59 (SD 11); female 88%) received a SSNB by an anaesthetist. At 6 weeks follow-up, the physiotherapy group showed a mean reduction in pain: 2.2 (95% CI 1.3 to 3.0) and improvement in function: -1.3 (95% CI -1.9 to -0.4). Similar changes were found in those treated by the anaesthetist (pain 1.3, (95% CI -1.18 to 3.80); function -1.4 (95% CI -3.18 to 0.35). Very small changes, that were not statistically significant, were found in quality of life (EQ5D-5L) scores. At 6 months follow-up, the mean reduction in pain (NRS) was maintained at 2.0 (95% CI 0.99 to 2.95) for the physiotherapy group.

### **Conclusion**

The results provide early, exploratory evidence that patients with persistent shoulder pain treated by physiotherapists using palpation-guided SSNBs achieve clinically important changes in pain and function in the short and medium term.

## **INTRODUCTION**

Persistent shoulder pain accounts for 15% of all musculoskeletal conditions and is associated with high patient burden and health care costs (Meislin et al., 2008; Borstad & Woeste, 2015). Among patients seeking treatment for their shoulder pain, approximately half have ongoing symptoms 12 months from first consulting a health professional (van der Windt et al., 1996; Chester et al., 2013; Laslett et al., 2015). When persistent, shoulder pain is often thought to be multifactorial involving pathology affecting more than one anatomical structure in the shoulder, potentially requiring more complex management (Meislin et al. 2005). It is therefore important to identify effective clinical interventions that can address multiple factors simultaneously for patients with persistent musculoskeletal shoulder pain.

There is a moderate level of evidence from two systematic reviews to support the short-term effectiveness (for 12 weeks or less) of suprascapular nerve block (SSNBs) injections for persistent shoulder pain compared to placebo (Favejee et al., 2011; Chang et al., 2016) and physiotherapist-led exercise (Chang et al., 2016). The usefulness of physiotherapist (PT)-led exercise in a chronically sensitised pain state requires careful consideration. Peripheral input to the central nervous system resulting from stretching or strengthening exercises, whilst useful in the long-term management, can stimulate peripheral nociceptors and further aggravate the nociceptive barrage and potentially worsen pain (Borstad & Woeste, 2015). Using SSNBs prior to providing a course of exercise could temporally break the afferent nociceptive input and create an opportunity to proceed with more effective exercise rehabilitation in the short, medium and long term (Bialosky et al., 2009). There is limited evidence to date that supports the addition of exercise after SSNB (Di Lorenzo et al., 2006; Kılıç et al. 2015).

SSNBs can be delivered using ultrasound, fluoroscopy and palpation-guided delivery techniques. It has been suggested that ultrasound and fluoroscopy techniques are less likely to result in serious complications such as pneumothorax and inadvertent neurovascular injury (Gorthi et al. 2010). However, evidence exists to support the landmark-guided palpation method as a safe method of delivering SSNBs (Shanahan et al., 2003; Shanahan et al., 2004).

### **Service Model**

At one National Health Service (NHS) hospital Trust in the West Midlands in England, patients with persistent shoulder pain had historically been referred to an anaesthetist for a therapeutic SSNB

performed under ultrasound guidance. Waiting times for the procedure usually exceeded more than one month, impacting negatively on the national 18 week referral to treatment target. This target was set by the NHS Constitution to ensure that patients (with non-urgent problems) should wait no longer than 18 weeks from general practitioner referral to treatment in secondary care (NHS England, 2013). Patients receiving SSNBs did not receive a physiotherapy referral following their nerve block, but would be followed up in a clinic by an orthopaedic surgeon to evaluate short-term outcomes and decide on further onward management if necessary e.g. referral to a pain clinic.

It was decided to re-develop the service to explore alternative ways to deliver SSNBs to improve access to SSNB procedures for patients with persistent shoulder pain and improve follow-up care. Advanced practitioner PTs based in secondary care, who had a specialist interest in shoulder pain management, were trained to perform palpation-guided SSNBs. All PTs were already trained and competent in injection therapy for the shoulder. Additional training in SSNBs was provided on a one to one basis in terms of a theoretical component of dose and risks as well as an observational component on technique by either a consultant anaesthetist or consultant physiotherapist. A variable amount of observational training was required depending on the individual physiotherapist, and ranged between one and five observed SSNBs. In addition to receiving a SSNB, patients were also prescribed home exercises from a PT. Patients received a six week follow-up appointment with a specialist PT, rather than the orthopaedic consultant. In addition, patients received a six month telephone follow-up by a physiotherapy assistant to establish medium-term clinical outcomes. This exploratory service evaluation collected patient reported outcome data from patients who received PT-led SSNBs in combination with exercise and provided an initial comparison with outcomes from patients who had received their SSNBs using ultrasound guidance from a medical doctor (in this case an anaesthetist) in combination with exercise for patients with persistent shoulder pain.

## **METHODS**

This prospective service evaluation was conducted in the physiotherapy department of an NHS hospital Trust in the West Midlands, England. The aim was to recruit up to 50 patients within one year as this has been the recommended number of patients to be involved in a service evaluation of this kind (CACG, 2008). It was anticipated some of the patients would have a SSNB using an ultrasound-guided technique by an anaesthetist to enable an exploration of the outcomes achieved for each of the two approaches. Outcome measures were collected at baseline (prior to receiving a SSNB), at six weeks (short-term outcomes) and at six months (medium-term outcome) following the SSNB. Patients provided written consent to be contacted by telephone review at six months as this was an additional requirement to their usual care. The service evaluation was approved and registered by the clinical effectiveness and audit team at the participating hospital Trust (ID 2865) prior to commencement. In the UK service evaluations do not require research ethical approval (NHS HRA, 2007), however ethical principles were considered (as recommended by Healthcare Quality Improvement Partnership) (Brain et al., 2011)) to ensure the service evaluation adhered to the recommended clinical governance standards.

### **Participant population and data collection process**

Patients were referred to physiotherapy from orthopaedic consultants, general practitioners, or PTs working in a primary care setting. All patients were aged 18 years and over and presented with persistent musculoskeletal shoulder pain defined as pain lasting greater than three months and having failed to respond to previous interventions. Patients were assessed by an advanced practitioner PT to determine suitability, prior to being offered a SSNB, which was provided one week later (as per standard practice).

Baseline data were collected in the PT clinic by the PTs immediately prior to the patient receiving the SSNB, regardless of whether the SSNB was provided by the anaesthetist or the PT. Baseline data included demographic data (age, gender and occupation), clinical characteristics (clinical diagnosis, previous treatment and pain duration, dominant arm and shoulder involved), and patient reported outcome measures (pain measured using the numerical rating scale (NRS) (Hawker, 2011), function measured using the patient specific functional score (PSFS) (Hefford et al., 2012; Koehorst et al.,

2014), and health related quality of life (measured using the EQ5D-5L) (König et al., 2009)). All three patient reported outcome measures are routinely collected in this NHS service. For all patients, outcomes at six weeks were collected at the clinical follow-up appointment with a PT. Follow-up data about pain intensity (NRS) at six months were collected at a telephone review by a physiotherapy assistant. Patient data were stored in a secure location in the physiotherapy department and aligned with hospital policy regarding confidentiality and anonymity.

### **SSNB delivery**

Participants received a single SSNB either by a PT using a palpation-guided technique (Meier technique as described by Fernandes et al. (2012a)) (see Figure 1), or by a consultant anaesthetist using an ultrasound-guided technique. At the time of making the appointment for the SSNB, it was not known whether the patients would receive SSNBs by the anaesthetist or a PT. The decision on who would provide the SSNB was based on clinician availability on the day. During the course of the service evaluation, a number of clinics had been arranged for the anaesthetist to be involved in providing ultrasound-guided SSNBs. Due to unforeseen personal and work commitments, the anaesthetist was only available to attend few of the planned sessions leading to a disproportionate number of patients seen by the advanced practitioner PTs. Within the injectate, all patients received a corticosteroid (40mg (1ml) methylprednisolone acetate) and an anaesthetic (either 100mg (10ml) Lidocaine hydrochloride or 50mg (10ml) Levobupivacaine). An anaesthetic volume of 10ml has been advocated for use in SSNBs (Fernandes et al. 2012b). Variability in anaesthetic medications meant that patients who had contraindications for one medication were able to receive a SSNB using the alternative medication. All SSNBs (including those delivered by the anaesthetist) were delivered in the PT department. All patients (including those who had received their SSNBs from the anaesthetist) were advised relative rest for a period of two days following the procedure and were provided with prescribed, individualised home exercises by a PT. The provision of home exercises was not standardised. If any of the patients struggled to understand the exercises prior to the SSNB, a further PT appointment was arranged for after the SSNB. Additional PT appointments were not necessarily with advanced practitioners but were provided by one of the other physiotherapists working in the shoulder pain service at the time.

## **Outcome measures**

### **Pain intensity (Numerical Rating Scale)**

Patients were asked to mark the 'worst' shoulder pain they had experienced in the preceding week on a Numerical Rating Scale (NRS 0-10; where 0 represented 'no pain at all' and 10 represented 'worst pain imaginable'). The 0-10 NRS for pain is a validated and frequently used measure to assess changes in shoulder pain in response to interventions (Hawker, 2011). A change of two points on a 0-10 point scale has been identified to represent a clinically meaningful change in shoulder pain (Michener, 2011). Change scores were calculated by subtracting the follow-up pain scores from the baseline pain scores. Therefore, 0 represented no change; positive values indicated an improvement and negative values represented worsening of pain. As SSNBs are primarily thought to have an effect on pain, the NRS was considered the primary outcome in this evaluation.

### **Function (Patient Specific Functional Score)**

The Patient Specific Functional Score (PSFS) is an outcome used to identify changes in physical function (Hefford et al., 2012; Koehorst et al., 2014). Patients were asked to identify up to three physical functions currently limited by their shoulder pain and rate each on the scale of 0 to 10, where 0 represents 'no function' to 10 which represents 'best function'. The score was taken as the mean score for the three functions. Change scores were calculated by subtracting the follow-up PSFS from the baseline PSFS. Therefore, 0 represented no change; negative values indicated an improvement and positive values represented worsening of function. Meaningful changes in function have been reported to be 1.2 points for upper extremity problems in general (Hefford et al., 2012), and 1.3 points for shoulder pain specifically (Koehorst et al. 2014). In this service evaluation a change of -1.3 points or more on the scale represented a meaningful improvement.

### **Health-related quality of life (EQ5D-5L)**

The EQ5D-5L (EuroQol Group, 2009) is a generic outcome measure, validated to identify changes in health-related quality of life (König et al., 2009). It has been reported to have a good correlation with shoulder-specific questionnaires (Paul et al., 2004). The scale asks five questions relating to physical and psychological domains, as well as asking the patient to score their health on a 0-100 health state

thermometer. An online electronic formula calculates scores (available at <http://www.euroqol.org/about-eq-5d/valuation-of-eq-5d/eq-5d-5l-value-sets.html>). The scores range from -0.11 (poor health) to 1 (full health) (Kind et al., 1998; Revicki et al., 2009). A clinically meaningful change in EQ5D-5L score has been identified as 0.10 for patients with chronic musculoskeletal pain conditions (Yoshizawa et al. 2016).

## **Data Analyses**

All analyses were performed using Statistical Package for the Social Sciences (SPSS), version 24 (<http://share.uoa.gr/public/Software/SPSS/SPSS24/Manuals/IBM%20SPSS%20Statistics%20Base.pdf>). Baseline continuous variables (age, pain, function and health-related quality of life) were reported as mean and standard deviation. Baseline categorical data (e.g. occupation and diagnosis) were reported as numbers and percentages. As this was an exploratory evaluation with a small sample of patients, and no means to balance the numbers in each group, we did not attempt to statistically compare the results of patients treated by PTs and medical doctors, but instead provide a descriptive analysis of changes in pain, function and quality of life over time. Paired samples t-tests were used for parametric data to test statistical significance of changes in scores from baseline to follow-up within each patient group. Success of the PT-led service was determined by mean pain scores reaching a meaningful improvement (at least 2 points on the 0-10 NRS) and statistically significant reduction in pain, compared to baseline, at 6 weeks and 6 months.



## RESULTS

A consecutive sample of 48 patients received SSNBs between July 2015 and July 2016 and were included in the service evaluation. All patients received their SSNB within one month from when the clinical decision to proceed with a SSNB was made. Of these, 40 received palpation-guided SSNBs from one of three PTs and eight received ultrasound-guided SSNBs from an anaesthetist.

Baseline results (table 1) indicated that both groups had similar characteristics for most variables. Patients in both groups generally had high pain scores (mean NRS=7.8) and low functional scores (mean PSFS=3.4) at baseline. All had received previous interventions, the majority of which were conservative treatments in the form of different treatment modalities used in physiotherapy and previous injections around the shoulder (intra-articular and/or soft-tissue). No patients had previously received SSNBs. The majority of patients in both groups were assessed clinically and diagnosed with multiple components contributing to their shoulder pain, for example rotator cuff disorder with acromio-clavicular joint osteoarthritis. Follow-up rates at six weeks were good, with data available for 45 patients (93%) for pain intensity (NRS), 42 patients (88%) for function (PSFS) and 43 patients (90%) for quality of life (EQ5D-5L). Follow-up rates remained good at six months, with pain intensity data available for 42 patients (88%). There were no reports of harm associated with the procedure, and none of the patients required anything other than standard after-care (30 minutes rest in the department following the SSNB). One patient (in the PT-led SSNB group) reported to have felt lightheaded following the procedure which resolved a few hours following the SSNB.

### Outcomes

Table 2 presents the results for at baseline, 6 weeks and, (for pain (NRS) measures) at 6 months follow-up, for both patient groups.

#### Pain intensity (Numerical Rating Scale)

Mean pain intensity decreased from 7.7 at baseline to 5.5 at 6 weeks follow-up and 5.7 at 6 months follow-up in the PT group. Mean improvement from baseline was clinically meaningful and statistically significant at 6 weeks (mean change 2.2; 95% CI 1.3 to 3.0), and at 6 months (mean change 2.0; 95% CI 0.99 to 2.95). In the anaesthetist group, mean pain intensity decreased from 7.8 to 6.5 at 6 weeks

and 5.3 at 6 months follow-up. Mean improvements in the anaesthetist group were not statistically significant at either time point, but did reach the pre-defined threshold for a clinically meaningful improvement at six months (see Table 2; Figure 2).

#### Function (Patient Specific Functional Score)

Mean function increased from 3.6 at baseline to 4.9 at 6 week follow-up in the PT group. Mean improvement was clinically meaningful and statistically significant at 6 weeks (mean change -1.3; 95% CI -1.9 to -0.4). In the anaesthetist group, mean function increased from 2.9 at baseline to 4.6 at 6 weeks. These changes were also clinically meaningful, but not statistically significant at 6 weeks (-1.41; -3.18 to 0.35).

#### Health-related quality of life (EQ5D-5L)

Health-related quality of life increased from 0.46 at baseline to 0.50 at 6 week follow-up in the PT group, and from 0.38 to 0.46 at 6 weeks in the anaesthetist group. The changes from baseline in neither group met the cut-point for meaningful change or were statistically significant ( $p \geq 0.05$ ).

.

## DISCUSSION

Patients with persistent shoulder pain receiving SSNBs delivered by advanced practitioner PTs using a palpation-guided technique with accompanying prescribed exercise reported clinically meaningful reductions in pain and function in the short term. Improvements in pain were maintained in the medium term. The improvements observed were similar to those achieved by ultrasound-guided SSNBs given by an anaesthetist. Findings from this service evaluation have resulted in a change to service delivery at the NHS hospital Trust in which the service evaluation was conducted. All patients attending the orthopaedic services who require a therapeutic SSNB are now referred to a PT rather than to an anaesthetist.

The mean change in pain at 6 weeks after the SSNB for the PT-led group was 2.2 which represented a clinically meaningful difference. Studies evaluating landmark-guided SSNBs on mixed pathology chronic shoulder patients have reported mean reductions in pain less than this: 1.2 at 4 weeks follow-up (Shanahan et al. 2004), 0.6 at one month follow-up (Taskaynatan et al., 2005), and 1.3 and 0.5 at 12 weeks follow-up (Shanahan et al., 2003; Shanahan et al. 2004). Unlike those previous studies, in this service evaluation SSNBs were provided by PTs in conjunction with prescribed, individualised exercise.

Previous studies have evaluated the benefit of SSNBs with physiotherapist-led exercises but it is not clear whether physiotherapists also provided the SSNBs (Dahan et al., 2000; DiLorenzo et al., 2006; Kılıç et al. 2015). To the authors' knowledge, this is the first formal evaluation of shoulder pain patients' outcomes from PTs providing SSNBs with exercise.

In respect of the injection technique, findings from this service evaluation are consistent with other reports that palpation-guided SSNBs are as safe as ultrasound-guided procedures (Jones & Chattopadhyay, 1999; Shanahan et al., 2003; Taskaynatan et al., 2006; DiLorenzo et al., 2006). This has implications for overall cost in terms of the ultrasound equipment, additional training requirements, and additional time to deliver a SSNB under ultrasound guidance. PTs providing the SSNBs instead of medical doctors could also lead to further cost reductions. The cost of a consultant anaesthetist providing ultrasound-guided injections compared to an advanced practice PT providing landmark-guided SSNBs (as was the case in this service evaluation) is nearly four times more expensive (unit costs of a landmark guided injection by a PT £39.00 versus ultrasound-guided

anaesthetist injection £149.00) (PSSRC, 2015). Delivering SSNBs using a palpation-guided method by PTs could potentially be an effective means of reducing health care costs in the management of patients with persistent shoulder pain.

The findings from this service evaluation could have implications for services in other UK healthcare settings. Patients with persistent pain who might benefit from SSNBs typically tend to receive their nerve blocks in secondary or tertiary-care settings (such as pain management clinics) by medical doctors often as a stand-alone treatment (Fernandes, 2012b). In the UK, patients often need to wait long periods to receive their treatment due to increasing pressures on these services. In the authors' opinion, rarely will a patient receive prescribed exercises at the same time as the delivery of a SSNB by a medical doctor. In some cases they will need to wait to be referred to see a PT following their SSNB, in other cases they will not receive any physiotherapy at all. If more PTs could provide SSNBs, patients could benefit from reduced waiting times to receive their SSNB as well as the benefits from prescribed exercises.

A large number of patients with musculoskeletal shoulder pain develop persistent shoulder pain. The patients taking part in this service evaluation had a mean duration of pain of 58 months (4.8 years). All had received other interventions, with poor outcomes, prior to receiving their SSNB. The mean pain reduction following SSNB with exercise presented here indicates that this intervention might be beneficial earlier in the care pathway. Future research should seek to identify which patients are at high risk of a poor outcome from common shoulder treatments, and which patients may potentially benefit from SSNBs.

This service evaluation is not without limitations. It is recognised that only limited information can be gained from evaluating the comparative group of patients who received SSNBs by the consultant anaesthetist under ultrasound guidance as numbers in this group were small and the design of the study was not a randomised trial. Any additional PT intervention received by patients in either group was not standardised nor recorded in detail in terms of type, frequency or intensity of exercise. The EQ5D-5L was the tool used to evaluate health related quality of life. Unlike the pain and functional outcomes, the EQ5D-5L did not show any statistically significant or clinically meaningful change. This questions the responsiveness of EQ5D-5L as an outcome measure for patients with shoulder pain. The evaluation also has some strengths: it is the first to provide an exploratory evaluation of SSNBs

delivered by PTs and presents outcomes up to 6 months after the intervention. No published research studies evaluating SSNBs to date have followed up participants after SSNB beyond 12 weeks. In addition it has provided some early suggestion that SSNBs delivered by PTs might be as effective as those provided by medical doctors. A recent study comparing efficacy of physiotherapists providing steroid injections (in this case to the sub-acromial region of the shoulder) compared to medical doctors reported equivocal outcomes (Marks et al., 2016). Research that tests the effectiveness of adding SSNBs to physiotherapist-led exercise for persistent shoulder pain is needed.

## **IMPLICATIONS**

This service evaluation provides exploratory evidence that SSNBs delivered by PTs using a palpation-guided approach achieved reductions in pain and improvements in function for patients with persistent shoulder pain. Research that investigates the clinical and cost-effectiveness of this treatment provided by PTs is needed. It could have the potential for wider use in PT practice for patients with persistent shoulder pain who have failed to respond or are likely to have a poor outcome from other treatments.

## **Key words**

Suprascapular nerve block; Physiotherapy.

**Table 1: Baseline characteristics of patients at baseline (n=48)**

		<b>Physiotherapist (Palpation-guided) SSNB (n=40)</b>		<b>Anaesthetist (Ultrasound-guided) SSNB (n=8)</b>	
		Mean (SD)	Number analysed	Mean (SD)	Number analysed
<b>Age</b>		56.6 (11.9)	40	58.6 (11.1)	8
<b>Pain duration (months)</b>		63 (115)	39	31 (39)	8
		<b>n (%)</b>		<b>n (%)</b>	
<b>Gender</b>	Females	25 (63)	40	7 (88)	8
<b>Occupation</b>	Unemployed/retired	10 (48)	21	4 (67) 0 (0)	7
	Desk worker	4 (19)		2 (33)	
	Manual worker	7 (33)	40		8
<b>Diagnosis</b>	Impingement	3 (8)		1 (13)	
	Adhesive capsulitis	5 (13)		0 (0)	
	Cuff dysfunction	3 (8)		1 (13)	
	AC OA	0 (0)		1 (13)	
	GH OA	1 (3)		0 (0)	
	Multiple	28 (68)		5 (61)	
<b>Previous Treatment</b>	None	0 (0)	32	0 (0)	7
	PT	2 (6)		1 (14)	
	Injection	2 (6)		0 (0)	
	Injection & PT	24(75)		4 (57)	
	Injection, PT& surgery	4 (13)		2 (29)	
<b>Dominant arm</b>	Right	32 (84)	38	6 (75)	8
<b>Shoulder involved</b>	Right	20 (51)	40	4 (50)	8

**Key:** AC= acromioclavicular; GH= glenohumeral; EQED-5L= Eurqol 5 dimension scale; Max<sup>m</sup>=maximum value; Min<sup>m</sup>=minimum value; n= number of participants; NRS= numerical rating scale; OA= Osteoarthritis; PSFS= Patient specific functional score; SD= standard deviation.

**Table 2: Summary statistics for outcomes across time points**

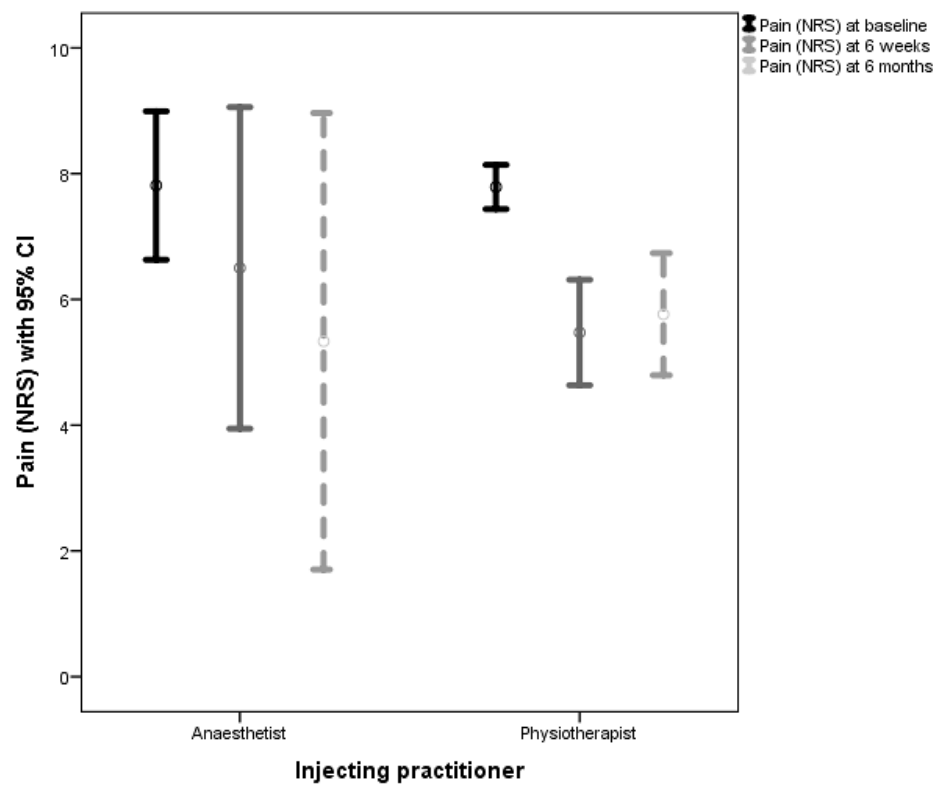
	<b>Baseline (mean, SD)</b>		<b>6 weeks (mean, SD)</b>		<b>6 months (mean, SD)</b>	
<b>Pain intensity (0-10 NRS)</b>		Number analysed		Number analysed		Number analysed
PT palpation guided SSNB	7.7 (1.1)	40	5.5 (2.5)	37	5.7 (2.9)	36
Anaesthetist US-guided SSNB	7.8 (1.4)	8	6.5 (8.0)	8	5.3 (3.5)	6
<b>Function (PSPF, range)</b>						
PT palpation guided SSNB	3.6 (2.0)	39	4.9 (2.4)	34		
Anaesthetist US-guided SSNB	2.9 (1.7)	8	4.3 (3.1)	8		
<b>Quality of life (EQ5D-5L)</b>						
PT palpation guided SSNB	0.461(0.220)	40	0.495 (0.226)	35		
Anaesthetist US-guided SSNB	0.379 (0.323)	8	0.457 (0.273)	8		

**Key:** BL= Baseline; EQED-5L= Eurqol 5 dimension scale; Max<sup>m</sup>=maximum value; Min<sup>m</sup>=minimum value; n= number of participants; NRS= numerical rating scale; PSFS= Patient specific functional score; SD= standard deviation; SD=standard deviation; SSNB= suprascapular nerve block.



**Figure 1: SSNB using landmark guided method**





**Figure 2: Mean point scores with 95% Confidence interval (CI) for pain (NRS) at baseline, 6 week and 6 month follow-up**

## REFERENCES

- Bayram, K.B., Bal, S. & Satoglu IS (2014) Does suprascapular nerve block improve shoulder disability in impingement syndrome? A randomized placebo-controlled study. *Journal of Musculoskeletal Pain*, 22(5). DOI: [10.3109/10582452.2014.883026](https://doi.org/10.3109/10582452.2014.883026)
- Bialosky, J.E., Bishop, M.D., Price, D.D., Robinson, M.E. & George, S.Z. (2009) The mechanisms of manual therapy in the treatment of musculoskeletal pain: a comprehensive model. *Manual Therapy*, 14(5), 531-538. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2775050/>
- Borstad, J. & Woeste, C. (2015) The role of sensitization in musculoskeletal shoulder pain. *Brazilian Journal of Physical Therapy*. DOI: [10.1590/bjpt-rbf.2014.0100](https://doi.org/10.1590/bjpt-rbf.2014.0100)
- Brain, J., Schofield, J., Gerrish, K. & Mawson, S. (2011) A Guide for Clinical Audit, Research and Service Review— An educational toolkit designed to help staff differentiate between clinical audit, research and service review activities. Available at: <http://www.hqip.org.uk/resources/hqip-guide-for-clinical-audit-research-and-service-review/>
- Clinical Audit Criteria and Guidance Working group (CACG) (2008) Healthcare Audit Criteria and Guidance. Available at: [http://www.hse.ie/eng/about/Who/qualityandpatientsafety/resourcesintelligence/Quality\\_and\\_Patient\\_Safety\\_Documents/guid.pdf](http://www.hse.ie/eng/about/Who/qualityandpatientsafety/resourcesintelligence/Quality_and_Patient_Safety_Documents/guid.pdf)
- Chang, K., Hung, C., Wu, W., Han, D., Yang, R. & Lin, C. (2016) Comparison of the Effectiveness of Suprascapular Nerve Block with Physical Therapy, Placebo, and Intra-articular Injection in Management of Chronic Shoulder Pain- a Meta-analysis of Randomized Controlled Trials. *Physical Medicine and Rehabilitation*, 97(8), 1366-1380. DOI: <https://doi.org/10.1016/j.apmr.2015.11.009>
- Chester, C., Shepstone, L., Daniell, H., Sweeting, D., Lewis, J. & Jerosch-Herold, C. (2013) Predicting response to physiotherapy treatment for musculoskeletal shoulder pain: a systematic review. *BMC Musculoskeletal Disorder*, 14:203 DOI: <https://doi.org/10.1016/j.apmr.2015.11.009>
- Dahan, T.H., Fortin, L., Pelletier, M., Petit, M., Vadeboncoeur, R. & Suissa, S. (2000) Double blind randomized clinical trial examining the efficacy of bupivacaine suprascapular nerve blocks in frozen shoulder. *Journal of Rheumatology*, 27, 1464-1469.
- Di Lorenzo, L., Pappagallo, M., Gimigliano, R., Palmieri, E., Saviano, E., Bello, A. ... Trombetti C. (2006) Pain relief in early rehabilitation of rotator cuff tendinitis: any role for indirect suprascapular nerve block? *European Journal of Physical and Rehabilitation Medicine*, 42(3), 195-204. Available at: <http://www.minervamedica.it/en/journals/europa-medicophysica/article.php?cod=R33Y2006N03A0195>
- EuroQol Group (2009) Health Questionnaire. English version for the UK. Available at [http://www.euroqol.org/fileadmin/user\\_upload/Documenten/PDF/Products/Sample\\_UK\\_English\\_EQ-5D-5L\\_Paper\\_Self\\_complete\\_v1.0\\_ID\\_24700.pdf](http://www.euroqol.org/fileadmin/user_upload/Documenten/PDF/Products/Sample_UK_English_EQ-5D-5L_Paper_Self_complete_v1.0_ID_24700.pdf)
- Favejee, M. M., Huisstede, B.M. and Koes, B.W. (2011). Frozen Shoulder: The Effectiveness of Conservative and Surgical Interventions - Systematic Review. *British Journal of Sports Medicine*, 45 (1), 49-56. DOI: <https://doi.org/10.1136/bjsm.2010.071431>
- Fernandes, M.R., Barbosa, M.A., Sousa, A.L. & Ramos, G.C. (2012a) Suprascapular nerve block: important procedure in clinical practice. Part II. *Revista Brasileira Reumatologica*, 52(4), 616-22.
- Fernandes, M.R., Barbosa, M.A., Sousa, A.L., Ramos, G.C. (2012b) Suprascapular nerve block: important procedure in clinical practice. *Brazilian Journal of Anesthesiology* 62(1): 96-104. DOI: <http://dx.doi.org/10.1590/S0482-50042012000400011>
- Gorthi, V., Moon, Y. & Kang, J. (2010) The Effectiveness of Ultrasonography-guided Suprascapular Nerve Block for Perishoulder Pain. *Healio Orthopaedics*, 33(4). Available at <http://www.healio.com/orthopedics/shoulder-elbow/journals/ortho/2010-4-33-4/%7Bed0c5347-6bd7-4fe1-8354-6cdfef1f5c0d5%7D/the-effectiveness-of-ultrasonography-guided-suprascapular-nerve-block-for-perishoulder-pain>

Hawker, G.A. (2011) Measures of Adult Pain. *Arthritis Care & Research*, 63:S240–S252.DOI: <https://doi.org/10.1002/acr.20543>

Jones, D.S. & Chattopadhyay, C. (1999) Suprascapular nerve block for the treatment of 423 frozen shoulder in primary care: a randomized trial. *British Journal of General Practice*, 49, 39-41. Available at: <http://bjgp.org/content/bjgp/49/438/39.full.pdf>

Hefford, C., Haxby Abbott, J., Arnold, R. & Baxter, D. (2012) The Patient-Specific Functional Scale: Validity, Reliability, and Responsiveness in Patients With Upper Extremity Musculoskeletal Problems. *Journal of Orthopaedic & Sports Physical Therapy*, 42(2), 56–65. DOI: <https://doi.org/10.2519/jospt.2012.3953>

Kind, P., Dolan, P., Gudex, C. & Williams, A. (1998) Variations in population health status: results from a United Kingdom national questionnaire survey. *British Medical Journal*, 316:736–741. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC28477/>

Klç, Z., Filiz, M.B., Çakr, T. & Toraman, N.F. (2015) Addition of Suprascapular Nerve Block to a Physical Therapy Program Produces an Extra Benefit to Adhesive Capsulitis: A Randomized Controlled Trial. *American Journal of Physical Medicine and Rehabilitation* 94(10 Supp1), 912-920. DOI: <https://doi.org/10.1097/PHM.0000000000000336>

König, H.H., Bernert, S., Angermeyer, M.C., Matschinger, H., Martinez, M., Vilagut, G....Alonso, J. (2009) Comparison of population health status in six European countries: results of a representative survey using the EQ-5D questionnaire. *Medical Care*, 47(2), 255-261. DOI: <https://doi.org/10.1097/MLR.0b013e318184759e>

Koehorst, M.L., van Trijffel, E. & Lindeboom, R. (2014) Evaluative measurement properties of the patient-specific functional scale for primary shoulder complaints in physical therapy practice. *Journal of Orthopaedic and Sports Physical Therapy*, 44(8),595-603. DOI: <https://doi.org/10.2519/jospt.2014.5133>

Laslett, M., Steele, M. & Hing, W. (2015) Shoulder pain in primary care- Part 2: Predictors of clinical outcome to 12 months. *Journal of Rehabilitation Medicine*, 47, 66–71. DOI: <https://doi.org/10.2340/16501977-1885>

Marks, D., Comansb, T., Thomasa, M., Ngb, S.K., O'Learyd, S., Conaghanf, P.G.....Bissetb, L. (2016) Agreement between a physiotherapist and an orthopaedic surgeon regarding management and prescription of corticosteroid injection for patients with shoulder pain. *Manual Therapy*, 26, 216-222. DOI: <http://dx.doi.org/10.1016/j.math.2016.10.001>

Meislin, R.J., Sperling, J.W. & Stitik, T.P. (2005) Persistent shoulder pain: epidemiology, pathophysiology, and diagnosis. *American Journal of Orthopaedics*, 34(12Supp), 5-9. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/16450690>

Michener, L.A., Snyder,A.R., Leggin, B.G. (2011) Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. *Journal of sport rehabilitation*, 20(1),115. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/21411827>

Nam, Y.S., Jeong, J.J., Han, S.H., Park, S.E., Lee, S.M., Kwon, M.J.I....Kim, K.S. (2011) An anatomic and clinical study of the suprascapular and axillary nerve blocks for shoulder arthroscopy. *Journal of Shoulder and Elbow Surgery*, 20,1061–1068. DOI: <https://doi.org/10.1016/j.jse.2011.04.022>

NHS England (2013) Referral to Treatment. Available at <https://www.england.nhs.uk/resources/rtt/>

NHS Health Research Authority (2007) Available at: <http://www.hra.nhs.uk/documents/2013/10/differentiating-audit-service-evaluation-and-research-version-1-1.pdf>

Paul, A., Lewis, M., Shadforth, M.F., Croft, P.R., van der Windt, D.A. & Hay, E.M. (2004) A comparison of four shoulder-specific questionnaires in primary care. *Annals of the Rheumatic Diseases*, 63,1293-1299. DOI: <https://dx.doi.org/10.1136%2Fard.2003.012088>

Personal Social Services Research Unit (2015) Available at: <http://www.pssru.ac.uk%2Fproject-pages%2Funit-costs%2F2015>

Revicki, D., Kawata, A.K., Harnam, N., Chen, W., Hays, R.D., Cella, D. (2009) Predicting EuroQol (EQ-5D) scores from the patient-reported outcomes measurement information system (PROMIS) global items and domain item banks in a United States sample. *Quality of Life Research*, 18(6), 783-791. DOI: <https://doi.org/10.1007/s11136-009-9489-8>

Shanahan, E., Ahern, M., Smith, M., Wetherall, M., Bresnihan, B. & FitzGerald, O. (2003). Suprascapular nerve block (using bupivacaine and methylprednisolone acetate) in chronic shoulder pain. *Annals of the Rheumatic Diseases*, 62(5), 400–406. DOI: <https://dx.doi.org/10.1136%2Fard.62.5.400>

Shanahan, E.M., Smith, M.D., Wetherall, M., Lott, C.W., Slavotinek, J., FitzGerald, O. & Ahern MJ. (2004) Suprascapular nerve block in chronic shoulder pain: are the radiologists better? *Annals of Rheumatic Diseases*, 63(9),1035-40. DOI: <https://doi.org/10.1136/ard.2003.015909>

Taskaynatan, M.A., Yilmaz, B., Ozgul, A., Yazicioglu, K., Kalyon, T.A. (2005) Suprascapular nerve block versus steroid injection for non-specific shoulder pain. *Tohoku J Exp Med*. 205, 19-25. Available at: [http://www.journal.med.tohoku.ac.jp/2051/TJ2051\\_03.pdf](http://www.journal.med.tohoku.ac.jp/2051/TJ2051_03.pdf)

van der Windt, D.A., Koes, B.W., Boeke, A.J., Devillé, W., De Jong, B.A.& Bouter, L.M. (1996) Shoulder disorders in general practice: prognostic indicators of outcome. *British Journal of General Practice* 46(410), 519-523.

Vadhanan, P., Tripaty, D.K., Adinarayanan, S. (2015) Physiological and Pharmacologic aspects of peripheral nerve blocks. *Journal of Anaesthesia*, 31(3), 384-393. DOI: <https://dx.doi.org/10.4103%2F0970-9185.161679>

Vorster, W., Lang, C.P., Briet, R.J., Labuschagne, B.C., duToit, D.F., Muller, C.J & de Beer, J.F. (2008) The sensory branch distribution of the suprascapular nerve: an anatomic study. *Journal of Shoulder and Elbow Surgery*, 17, 500-502. DOI: <https://doi.org/10.1016/j.jse.2007.10.008>

Yoshizawa K, Kobayashi, H., Fujie, M., Ogawa, Y., Yajima, T. & Kawai, K. (2016) Estimation of minimal clinically important change of the Japanese version of EQ-5D in patients with chronic noncancer pain: a retrospective research using real-world data. DOI: 10.1186/s12955-016-0438-2